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Updated checklist of estuarine caridean shrimps (Decapoda: Caridea) from the southern region of Laguna Madre, Tamaulipas, Mexico, with new records and a key for taxonomic identification

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Abstract

We provide an updated list of the caridean shrimp species from the southern region of the Laguna Madre, Tamaulipas, Mexico, along with a key for taxonomic identification. The survey was conducted in 3 sites during 3 temporal seasons. A total of 2,989 specimens were collected belonging to 12 species, 6 genera, and to the following 4 families: Alpheidae, Hippolytidae, Palaemonidae, and Processidae. Hippolytidae was the most abundant family, followed by Palaemonidae, Alpheidae, and Processidae. The hippolytid *Hippolyte obliquimanus* Dana, 1852, the palaemonids *Palaemon floridanus* Chace, 1942, and *P. northropi* (Rankin, 1898), and the alpheid *Alpheus* cf. *packardii* Kingsley, 1880 represent new records for the Laguna Madre and selected areas of the Gulf of Mexico.

Key words

Estuary; crustacean; hypersaline; new record; Neartic; Neotropical.

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Introduction

The Decapoda Latreille, 1802 represent one of the most diverse orders within the crustaceans. With almost 3,500 species described, caridean shrimps constitute the most diverse group of shrimp-like crustaceans (De Grave and Fransen 2011). They have ecological relevance due to their presence in a great variety of habitats (Bauer 2004). In coastal estuaries, they represent a numerically abundant component, playing an important role as links that transfer energy to higher levels of the food web (Almeida et al. 2013), recycling nutrients through fecal deposi-tions and contributing to the maintenance of submerged aquatic vegetation (SAV) habitats (Barba-Macías 2012).

The Laguna Madre of Tamaulipas is the largest coastal lagoon in Mexico (Contreras and Castañeda 2004), and together with Laguna Madre of Texas, form the largest hypersaline system in the world (Tunnell and Judd 2002). It is placed under the influence of 2 biogeographic regions and 2 marine provinces, making it a dynamic, wide ecotone (Escobar-Briones 2004, Aubriot et al. 2005) that supports a rich variety of organisms from both freshwater and marine environments. It also has an estuarine biota

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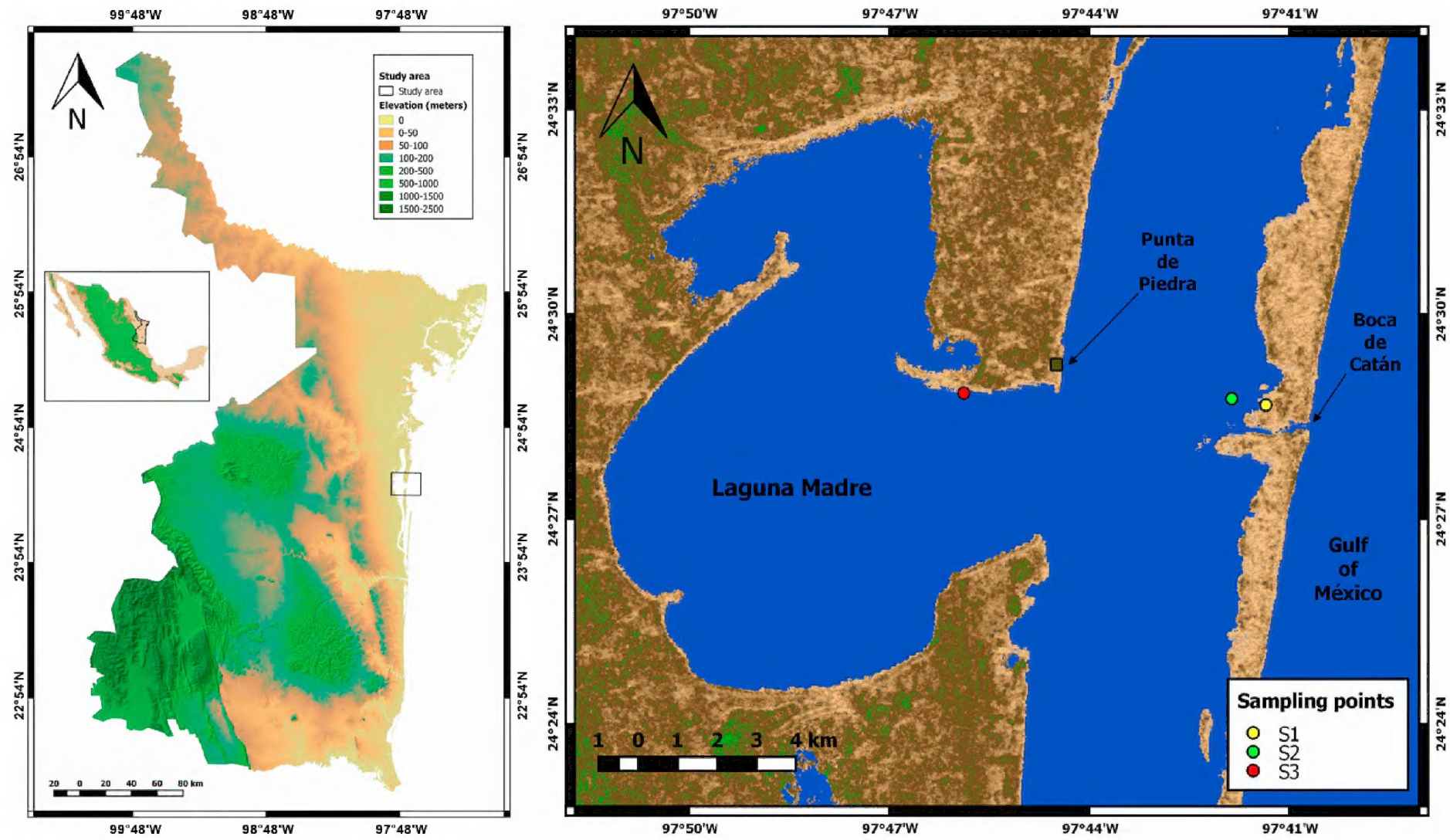

Figure 1. Sampling points considered for this work in the southern region of Laguna Madre, Tamaulipas, Mexico.

(Contreras and Castañeda 2004) which use the great extent of habitats for shelter, feeding, and as nursing areas.

Among the faunistic groups occurring in Laguna Madre of Tamaulipas, crustaceans account for a total of 96 species (Leija-Tristán et al. 2000); regarding caridean shrimp community Leija-Tristán et al. (2000) found 14 species in the Mexican basin, and most of the subsequent surveys recorded 9 (Barba-Macías 1999, Rodríguez-Almaraz et al. 2000, Barba-Macías et al. 2005) and 7 species (Barba-Macías 2012). All of these studies found the Alpheidae, Hippolytidae, and Palaemonidae to be the 3 main families, with occasional occurrences of Processidae, and underlined the strong association between this decapod group and SAV habitats.

In Laguna Madre, SAV is the most important primary producer (Rendón Von-Osten and García-Guzmán 1995), and greatly determines the abundance and richness of estuarine benthic biota (Barba-Macías et al. 2005). This occurs due to the spatial complexity provided by these vegetated areas, compared with bare substrates which, instead, do not serve either as foraging or sheltering grounds against predators (Llanso et al. 1998).

Knowledge about caridean shrimps in the study area has been less updated than that regarding the structure and ecology of edible crustaceans. Furthermore, the taxonomy of some groups is complex or under revision (Román-Contreras and Martínez-Mayén 2010, Vera-Caripe et al. 2012, Almeida et al. 2012), resulting in scattered knowledge. Our main objective is to provide an updated list of the caridean shrimps occurring in the southern area of Laguna Madre of Tamaulipas, as well as a key for taxonomic identification of the species.

Methods

Study area. The Laguna Madre is situated in the coastal plain of the Gulf of Mexico, in the states of Tamaulipas, Mexico and Texas, USA (Rendón-von Osten and García-Guzmán 1995). On the Mexican side, it has a shoreline of approximately 160 km long from Río Bravo delta in the north to Río Soto la Marina at south, covering an area of 272,844.6 ha (Carrera 2004). The climate in the southern region is hot and semiarid; the mean annual temperature is 24.3 °C (17 °C in January and 29.6 °C in June); the mean annual precipitation is 748 mm, with the rainy season ranging from June to October (Tunnel and Judd 2002). The hydrology of the system is characterized by a mean salinity of 41.2‰ (33.5–63), a temperature of 25.9 °C (Contreras and Castañeda 2004), an average dissolved oxygen of 4.5–6.3 mg/L, and a pH of 8.4–9.0 (Leija-Tristán 2005).

The poor drainage from the land into the lagoon provides several components involved in the natural biogeochemical cycles, but also transports substances such as pesticides, heavy metals, agricultural fertilizers and domestic waste, derived mainly from anthropogenic activities around the basin (Bello-Pineda et al. 2009).

Our work was carried out in the southern region of Laguna Madre, at 3 sampling stations (Table 1; Fig. 1), adjacent to the inlet Boca de Catán and the neighboring

Table 1. Collection sites in the southern region of Laguna Madre, Tamaulipas, Mexico.

Station	Latitude (N)	Longitude (W)
1 (S1)	24°29.1000′	097°41.4500′
2 (S2)	24°29.1833′	097°41.9667′
3 (S3)	24°29.1000′	097°41.4500′

town of Punta de Piedra, Tamaulipas (Fig. 1). Station 1 (S1) is located nearby an inlet, it is influenced by daily tidal regimes and presence of oyster reefs. Station 2 (S2) is adjacent to a deep tidal channel, over a flooded sediment flat covered with seagrass. Station 3 (S3) is located 2 km west to Punta Piedra town, at the edge of an internal basin called Bahía de Catán. This area was selected for its fisheries activities and the presence of seagrass meadows, which are habitats for the caridean shrimps.

Sampling methods. The collections were made in 3 seasons—March (dry season) and August 2014 (rainy season), and February 2017 (northern winds season)—at each of the 3 sites, in order to cover a whole year of seasonal variations.

At each site, the sampling procedure consisted of 5 separate points along 2 linear transects of 23 m each over seagrass-covered substrates. Caridean shrimps were collected by sieving over the seagrass leaves, removing incidental sediments and vegetation, selecting the specimens with tweezers. Specimens were stored in a jar with salt water and later preserved in 90% isopropyl alcohol. Additionally, seagrass samples were randomly collected within the same sampling area, stored in plastic bags and preserved in ice for processing in the laboratory.

The species were identified according to Holthuis (1950, 1952), Chace (1972), Williams (1984), Abele and Kim (1986) and Hernández et al. (2005). A ZEISS Stemi DV4 stereoscopic microscope and a LEICA EZ4HD with added camera were used for specimen observation and photography, respectively.

The families, as well as the species and their synonyms are listed following the criteria of De Grave and Fransen (2011), and the taxa within the families are ordered alphabetically. Additional information, such as distribution or morphological observations is summarized from the above-mentioned literature. The collected specimens were deposited in the Carcinological Collection of the Biological Sciences Faculty of Autonomous University of Nuevo León (UANL-FCB-C). Vouchers for each record are presented in the Results. Seagrass were processed by washing them to remove the sediment from the leaves. The seagrass species were determined by observing vegetative structures such as shoots and leaves (Dawes et al. 2004).

Results

A total of 2,989 shrimp specimens were identified belonging to 4 families, 6 genera and 12 species. The seagrass samples identification showed an integrated community of 3 species: *Syringodium filiforme* Kütz., *Halodule wrightii* Asch. and *Thalassia testudinum* Banks & Sol. ex K.D. Koenig.

Superfamily Palaemonoidea Rafinesque, 1815

Family Palaemonidae Rafinesque, 1815

Leander tenuicornis (Say, 1818)

Material examined (16 specimens). 5 August 2014 (UANL-FCB-C17-8139), S2 (24°29.1833′ N, 097° 41.9667′ W), among seagrass of *Syringodium filiforme* and *Halodule wrightii*, 3 specimens (2♀, 1♂); 5 August 2014 (UANL-FCB-C17-8149), S3 (24°29.2667′ N, 097°45.9833′ W), same habitat, 13 specimens (8♀, 5♂).

Distribution. Western Atlantic Ocean: Canada, USA (Massachusetts, Virginia, North Carolina, South Carolina, Florida, Louisiana and Texas), Bermudas, Mexico, Panama, Bahamas, Cuba, Jamaica, Puerto Rico, Virgin Islands, Colombia, Venezuela, Brazil, Malvinas Islands. Oriental Atlantic Ocean: Azores Archipelago. Mediterranean: Spain, France, Italy and Libya. Pacific and Indian oceans: Red Sea, India, Japan, Papua New Guinea, Australia and New Zealand (Ferreira et al. 2010).

Previous records from Laguna Madre. Leija-Tristán et al. (2000); Rodríguez et al. (2000).

Remarks. The morphology of our specimens agrees with the description provided by Abele and Kim (1986). Specimens were more easily identified by observing the stylocerite reaching to distal third of basal antennular segment and the deep rostrum of females, rather than the shallow one showed by males.

Palaemon floridanus Chace, 1942

Figure 2A, B

Material examined (46 specimens). Among seagrass meadows. 5 August 2014 (UANL-FCB-C17-8143), S2 (24°29.1833′ N, 097°41.9667′ W), 11 specimens (9♀, 2♂); 5 August 2014 (UANL-FCB-C17-8147), S3 (24°29.2667′ N, 097°45.9833′ W), same habitat, 35 specimens (16♀, 19♂); 18 February 2017 (UANL-FCB-C17-8161), S3 (same previous point), 1 specimen (♂).

Distribution. Florida, Panama, Belize, Texas, Mexico (Laguna Madre, Tamaulipas [this study, new record]) (Chace 1972; Holthuis 1952; Coen et al. 1981; Strenth and Chace 1995; Baeza and Fuentes 2012).

Previous records from Laguna Madre: None. New record.

Remarks. This species is closely related with *Palaemon northropi* (Rankin, 1898), from which it was differentiated by Chace (1942) by the shape and dentition of the rostrum, the second legs, which have distinctly longer fingers, and the more slender and longer dactyli of the third pereopods (Holthuis 1952). Nevertheless, the most consistent identification character is the shape of the rostrum, which is slender and possesses more teeth on the ventral margin than in *P. northropi* (Holthuis 1952) (Fig. 2A). Our specimens typically showed 5 teeth on the ventral margin of rostrum.

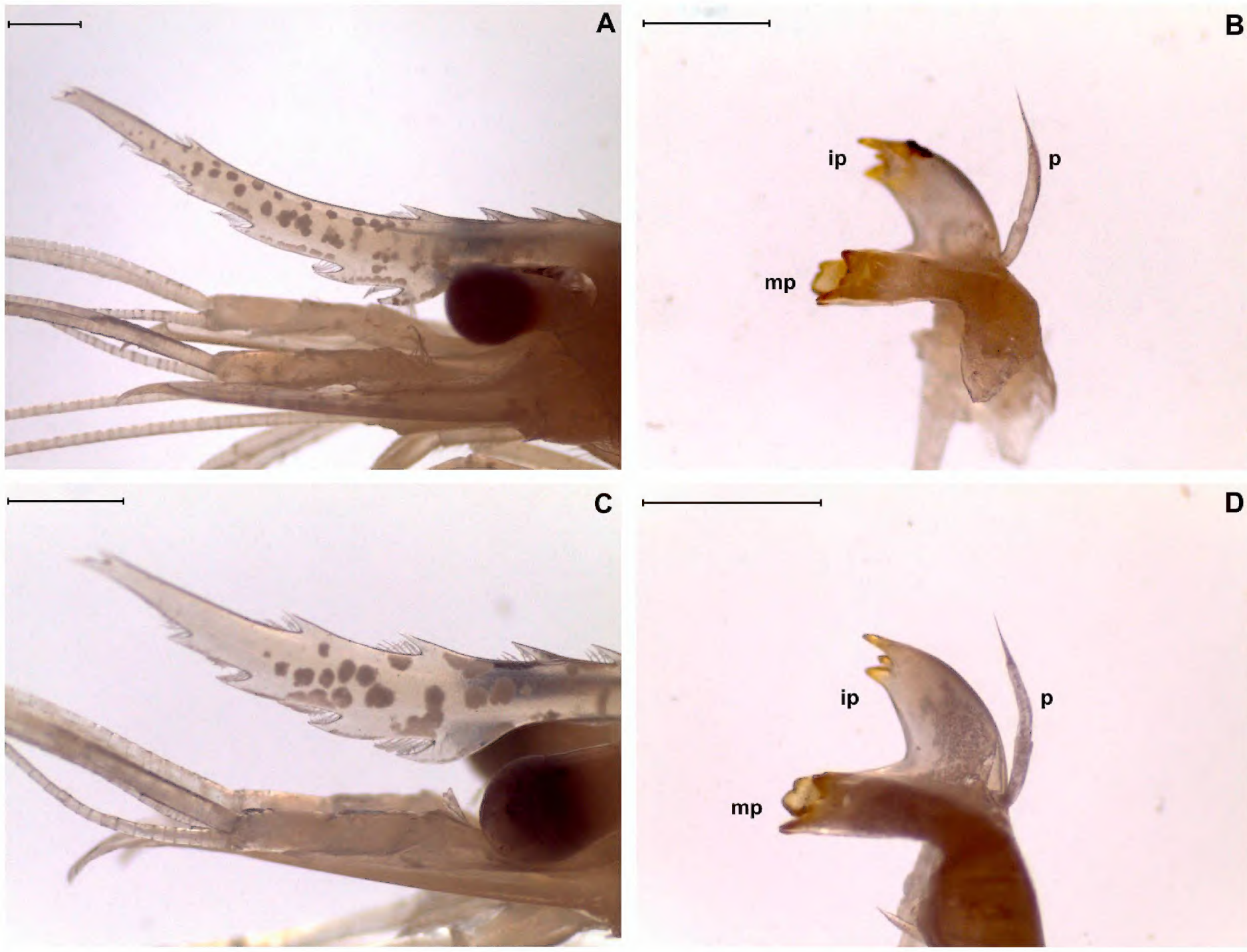

Figure 2. A, B. *Palaemon floridanus*, male (UANL-FCB-C17-8147): (**A**) anterior region lateral view; (**B**) mandible lateral view. **C, D.** *Palaemon northropi*, male (UANL-FCB-C17-8142): (**C**) anterior region lateral view; (**D**) mandible lateral view. Scale bars = 1 mm. (ip: incisor process; mp: mandibular process; p: palp).

Palaemon northropi (Rankin, 1898)

Figure 2C, D

Material examined (8 specimens). Among seagrass beds. 5 August 2014 (UANL-FCB-C17-8142), S2 (24° 29.1833′ N, 097°41.9667′ W), 5 specimens (2♀, 3♂); 5 August 2014 (UANL-FCB-C17-8146), S3 (24°29.2667′ N, 097°45.9833′ W), 3 specimens (1♀, 2♂).

Distribution. Eastern American coastal regions from Bermuda to Brazil (Holthuis 1952; Ferreira et al. 2010); Mexico: Bahía de Chetumal (Castellanos-Osorio 2009), Laguna de Términos, Campeche; Bahía de la Ascención, Quintana Roo (Chace 1972, Román-Contreras 1988, Wicksten 2005a); Laguna Madre, Tamaulipas (this study [new record]).

Previous records from Laguna Madre. None. New record.

Remarks. This species can be confused with *Palaemon floridanus*, from which it differs by bearing 3 or 4 ventral teeth in the rostrum (Fig. 2C).

Palaemon mundusnovus De Grave & Ashelby, 2013

Figure 3A, B

Material examined (150 specimens). Among seagrass. 8 March 2014 (UANL-FCB-C17-8119), S1 (24°29.1000′ N, 097°41.4500′ W), 49 specimens (5♀, 44♂); 8 March 2014 (UANL-FCB-C17-8123), S2 (24°29.1833′ N, 097°41.9667′ W), 1 specimen (♂); 9 March 2014 (UANL-FCB-C17-8130), S3 (24°29.2667′ N, 097°45.9833′ W), 14 specimens (5♀, 9♂); 4 August 2014 (UANL-FCB-C17-8133), S1 (same point), 86 specimens (30♀, 57♂); 18 February 2017 (UANL-FCB-C17-8162), S3 (same point), 43 specimens (29♀, 14♂).

Distribution. Vineyard Sound, Massachusetts, to Port Aransas, Texas (Holthuis 1952); Laguna de Mecoacán, Tabasco; Laguna de Términos, Campeche; Bahía de la Ascensión, Quintana Roo; Isla Arenas, Yucatán, México (Chace 1972, Williams 1984, Román-Contreras 1988, Domínguez et al. 2003, Barba-Macías et al. 2005, Wicksten 2005a, Barba-Macías 2012).

Previous records from Laguna Madre. Hildebrand (1958), Barba-Macías (1999), Leija-Tristán et al. (2000), Rodríguez-Almaraz et al. (2000), Sheridan and Minello (2003, Laguna Madre of Texas), Barba-Macías et al. (2005), Barba-Macías (2012).

Remarks. The rostrum bears 4 or 5 ventral teeth, seldom 3; our material typically showed 4 ventral teeth, ranging

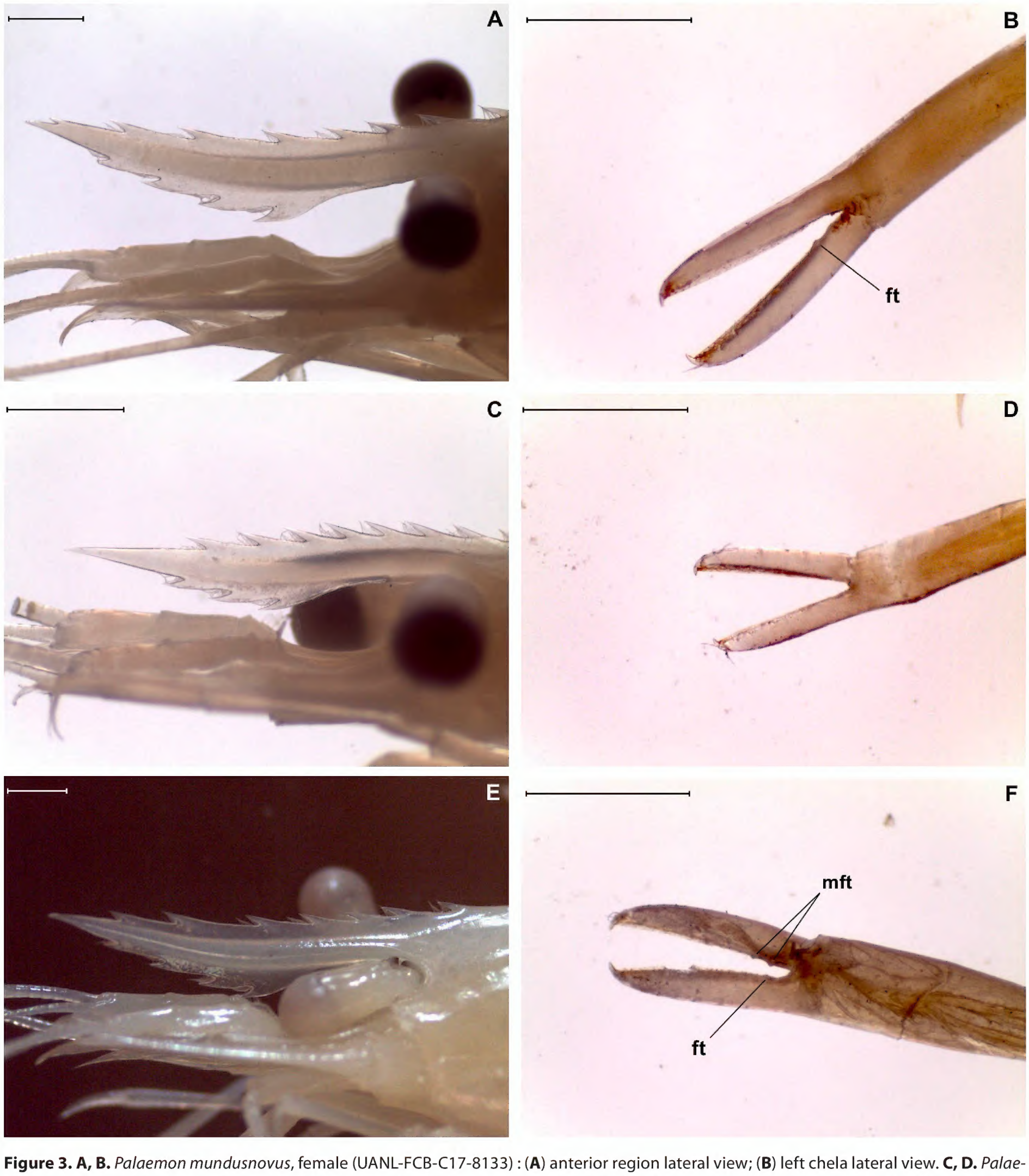

Figure 3. A, B. *Palaemon mundusnovus*, female (UANL-FCB-C17-8133) : (**A**) anterior region lateral view; (**B**) left chela lateral view. **C, D.** *Palaemon pugio*, male (UANL-FCB-C17-8134): (**C**) anterior region lateral view; (**D**) left chela lateral view. **E, F.** *Palaemon vulgaris*, female (UANL-FCB-C17-8122): (**E**) anterior region lateral view; (**F**) left chela lateral view. Scale bars = 1 mm. (ft: finger tooth; mft: movable finger tooth).

from 3 to 5 (Fig. 3A), and agreed with descriptions given by Abele and Kim (1986), and also Holthuis (1952), particularly in the number of ventral teeth of rostrum, the dorsal teeth behind the margin of orbit, and also the presence of a blunt and tiny tooth on the dactylus of second pereopod. This species is reported as *Palaemonetes intermedius* in all the literature, but following the transfer of *P. intermedius* (Holthuis, 1949) to the genus *Palaemon*, the name became the junior homonym of *Palaemon intermedius* Stimpson, 1860. Thus, De Grave and Ashelby (2013) proposed the replacement name now in use. All members of the genus *Palaemonetes* were transferred to *Palaemon* by these authors based on morphological, cladistic and genetic evidence (Pereira 1997, Ashelby et al. 2012, De Grave and Ashelby 2013), concluding that the presence/absence of mandibular palp can no longer be used as the sole character that separates both genera. Furthermore, larval development studies comparing 3 coastal *Palaemonetes* species with 3 species of *Palaemon* concluded that the differences within the genera are more pronounced that between genera, which suggests a close evolutionary relationship (Knowlton and Vargo 2004).

***Palaemon pugio* (Holthuis, 1949)**

Figure 3C, D

Material examined (22 specimens). Among seagrass beds. (UANL-FCB-C17-8120), S1 (24°29.1000′ N, 097° 41.4500′ W), 1 specimen (♀); 8 March 2014 (UANL-FCB-C17-8125), S2 (24°29.1833′ N, 097°41.9667′ W), 1 specimen (♂); 4 August 2014 (UANL-FCB-C17-8134), S1 (same point), 17 specimens (6♀, 11♂); 5 August 2014 (UANL-FCB-C17-8145), S3(24°29.2667′ N, 097° 45.9833′ W), 3 specimens (♀); 18 February 2017 (UANL-FCB-C17-8163), S3 (same point), 11 specimens (7♀, 4♂).

Distribution. Quebec; near Yarmouth, Nova Scotia; Newcastle and East Brunswick, Maine; northern Massachusetts to Texas; intermittent from Verte River, 3 miles to the west of St Modeste (Holthuis 1952, Williams 1974, 1984, Abele and Kim 1986); islands and coastal lagoons from Veracruz to Campeche; Puerto Progreso, Yucatán; Akumal, Quintana Roo (Zarur 1962, Román-Contreras 1988, Rodríguez et al. 2000, Domínguez et al. 2003, Barba-Macías et al. 2005, Barba-Macías 2012).

Previous records from Laguna Madre. Hildebrand (1958, 1969), Román Contreras (1988), Barba-Macías (1999), Rodríguez et al. (2000), Leija-Tristán et al. (2000), Sheridan and Minello (2003), Barba-Macías et al. (2005), Barba-Macías (2012).

Remarks. This species is recognized by having an unarmed stretch in both sides of the rostrum before a dagger-shaped tip, and 2–5, generally 3, ventral teeth. The fingers of second pereiopod are without teeth on their cutting edges (Abele and Kim 1986) (Fig. 3C, D). Our material agreed with the previous features.

***Palaemon vulgaris* Say, 1818**

Figure 3E, F

Material examined (187 specimens). In seagrass beds, tidal zones and presence of oyster reefs. 8 March 2014 (UANL-FCB-C17-8118), S1 (24°29.1000′ N, 097° 41.4500′ W), 1 specimen (♂); 8 March 2014 (UANL-FCB-C17-8122), S2 (24°29.1833′ N, 097°41.9667′ W), 96 specimens (62♀, 34♂); 4 August 2014 (UANL-FCB-C17-8135), S1 (same point), 15 specimens (♀); 5 August 2014 (UANL-FCB-C17-8141), S2 (same point), 75 specimens (40♀, 35♂); 17 February 2017 (UANL-FCB-C17-8154), S1(same point), 104 specimens (45♀, 59♂); 17 February 2017 (UANL-FCB-C17-8157), S2 (same point), 64 specimens (30♀, 34♂).

Distribution. Southern Gulf of St Lawrence, southward to Cameron County, Texas; Laguna de Tamiahua, Veracruz; Laguna Mecoacán, Tabasco; Río Champotón, Laguna de Términos, Campeche; near Progreso, Yucatán; Puerto Morelos, Punta Hualapich and Akumal, Quintana Roo (Holthuis 1952, Williams 1984, Abele and Kim 1986, Román-Contreras 1988, Barba-Macías et al. 2005, Barba-Macías 2012).

Previous records from Laguna Madre. Barba-Macías (1999), Sheridan and Minello (2003), Sheridan (2004, Laguna Madre of Texas), Barba-Macías et al. (2005), Barba-Macías (2012).

Remarks. The rostrum has 2 teeth on dorsal series behind posterior margin of orbit, 3–5 ventral teeth, the dactylus of the second pereopod is armed with 2 teeth and the immovable finger with 1 tooth on its cutting edge. Our material agreed with descriptions given by Holthuis (1952), Williams (1984), and Abele and Kim (1986). This species was also part of the re-appraisal of the genus *Palaemonetes* made by De Grave and Ashelby (2013).

Superfamily Alpheoidea Rafinesque, 1815

Family Alpheidae Rafinesque, 1815

***Alpheus heterochaelis* Say, 1818**

Figure 4A–C

Material examined (9 specimens). In seagrass beds. 8 March 2014 (UANL-FCB-C19-8127), S2 (24°29.1833′ N, 097°41.9667′ W), 5 specimens (4♀, 1♂); 4 August 2014 (UANL-FCB-C19-8136), S1(24°29.1000′ N, 097°41.4500′ W), 3 specimens (1♀, 2♂); 5 August 2014 (UANL-FCB-C19-8144), S3 (24°29.2667′ N, 097°45.9833′ W), 1 specimen (♂); 17 February 2017 (UANL-FCB-C19-8151), S1 (same point), 5 specimens (4♀, 1♂); 18 February 2017 (UANL-FCB-C19-8158), S3 (same point), 2 specimens (♀).

Distribution. Lower portion of Chesapeake Bay (USA) to South and West, through the Gulf of Mexico, Cuba, Curaçao, Bermuda, Suriname and Brazil (Verrill 1922, Chace 1972, Williams 1984, McClure 2005); in Mexico, from Veracruz to Quintana Roo (Román-Contreras 1988, Markham et al. 1990, Hermoso-Salazar and Martínez-Guzmán 1991, Hernández et al. 1996, Rodríguez et al. 2000).

Previous records from Laguna Madre. Barba-Macías (1999); Rodríguez et al. (2000); Leija-Tristán et al. (2000); Sheridan and Minello (2003); Sheridan (2004); Barba-Macías et al. (2005).

Remarks. Our material agreed with descriptions by Chace (1972) and McClure (2005) regarding male propodus of major first chelae, showing deep notches on both ventral and dorsal margins and the merus of first pereopods unarmed distoventrally (Figure 4B, C).

***Alpheus* cf. *packardii* Kingsley, 1880**

Figure 4D–F

Material examined (25 specimens) Among seagrass meadows, in shallow waters adjacent to deeper areas. 8 March 2014 (UANL-FCB-C19-8126), S2 (24°29.1833′ N, 097°41.9667′ W), 14 specimens (7♀, 7♂); 9 March 2014 (UANL-FCB-C19-8131), S3 (24°29.2667′ N, 097° 45.9833′ W), 11 specimens (4♀, 7♂).

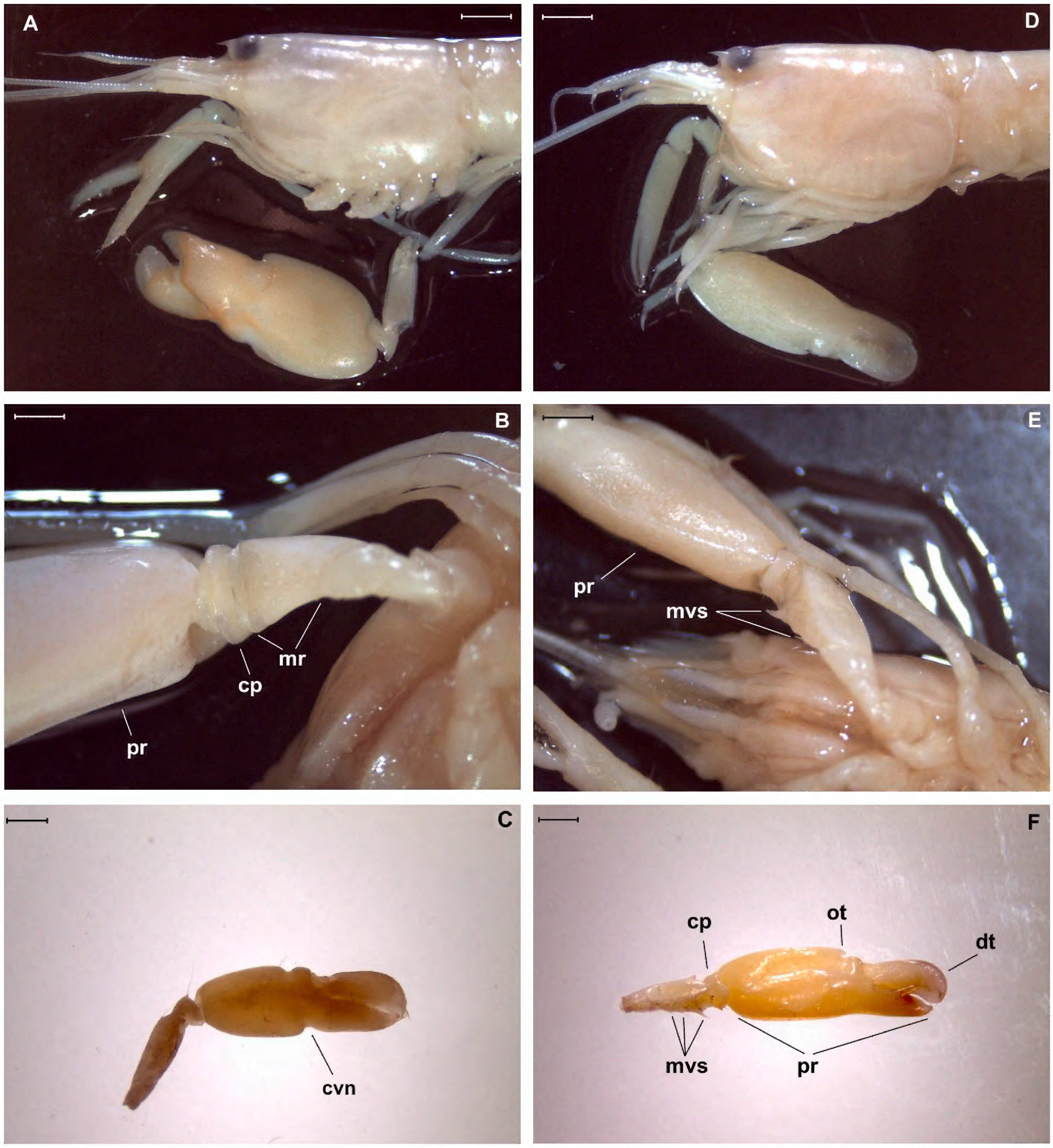

Figure 4. A–C. *Alpheus heterochaelis*: (**A**) female (UANL-FCB-C19-8151), anterior margin lateral view; (**B**) male (UANL-FCB-C19-8144), first left pereiopod ventral view ; (**C**) female (UANL-FCB-C19-8127), major chela lateral view. **D–F.** *Alpheus* cf. *packardii*: (**D**) female (UANL-FCB-C19-8126), anterior margin lateral view; (**E**) first left pereiopod ventral view; (**F**) female (UANL-FCB-C19-8126), major chela lateral view. Scale bars = 1 mm. (cp: carpus; dt: dactylus; ot: overhanging tooth; pr: propodus; cvn: chela ventral notch).

Distribution. Western Atlantic: Bermuda; North Carolina to Florida; Gulf of Mexico; throughout the Caribbean Sea; Brazil (Anker et al. 2016). In Mexico: Bahía de la Ascensión, Bahía del Espíritu Santo, Arrecife Mahahual (Román-Contreras and Martínez-Mayén 2010); Isla Verde, Arrecife Hornos, Isla de Sacrificios, Isla de Enmedio, Veracruz (Hermoso-Salazar and Arvizu-Coyotzi 2015); Laguna Madre, Tamaulipas (this study [new record]).

Previous records from Laguna Madre. None. New record.

Remarks. Kingsley (1878) described *Alpheus normanni* based on material from the Pacific coast of Panama. Two years later, he described *A. packardii* based on specimens from Key West, Florida (Kingsley 1880). Chace (1937) considered both as identical morphologically, and placed *A. packardii* as a synonym of *A. normanni*. Several authors continued treating these species as synonyms or only reported *A. normanni* for the western Atlantic (Williams 1965, Chace 1972, Christoffersen 1979, Williams 1984, Abele and Kim 1986, McClure 2005). Nevertheless, Kim and Abele (1988) compared material from

the eastern Pacific and western Atlantic (Florida), and found consistent morphological differences in the form of the male minor chelae, being more elongated in the Pacific specimens (5.8 times as long as broad); thus, they removed *A. packardii* from the synonymy of *A. normanni*. The minor chelae of the males we examined ranges from 3.17–4.67 times as long as broad, which overlaps the range of 3.64–4.38 described by Román-Contreras and Martínez-Mayén (2010) as an argument to conclude their material belongs to *A. packardii* species complex. Moreover, our material is morphologically similar to specimens identified also as *A.* cf. *packardii* or *A. packardii* (Soledade and Almeida 2013, Giraldes and Freire 2015, Anker et al. 2016, see figures). Additionally, according to Christoffersen (1998), the western Atlantic specimens previously named as *A. normanni* must be attributed to *A. packardii*.

Regardless the above, both species are part of the transisthmian *A. normanni–A. packardii* species complex that is currently being revised (Anker et al. 2016, Anker and Santos unpubl.). Species complexes are relatively common within highly species-rich caridean taxa like the genus Alpheus, which comprises many species with very similar morphology, even in the presence of high genetic or protein divergence (Knowlton et al. 1993, McClure and Greenbaum 1994, Knowlton and Weight 1998, Mathews et al. 2002). This has led to nomenclatural confusion, and the taxonomic identity of the western Atlantic material identified as *A. normanni* will need to be carefully re-assessed since it is quite possible that it refers to more than 1 species (Anker et al. 2016).

The presence of several cryptic taxa within the genus *Alpheus* from eastern Pacific and western Atlantic (Williams et al. 2001), the molecular, morphological, coloration patterns and distributional evidence showing that *A. normanni* and *A. packardii* are different, as well as the existence of at least 5 undescribed cryptic species belonging to *normanni–packardii* complex (3 in western Atlantic and 2 in the eastern Pacific) (Almeida et al. 2007, Román-Contreras and Martínez-Mayén 2010, Vera-Caripe et al. 2012, A. Anker pers. com.) makes the taxonomy unsettled for both, but the establishment of several separate species is the likely outcome. Thus, in this work we identified the collected specimens as *Alpheus* cf. *packardii* for the aforesaid considerations, evidence and taxonomic issues, and because recent studies have used the name *A. packardii* for records from the Gulf of Mexico (Román-Contreras and Martínez-Mayén 2010, Hermoso-Salazar and Arvizu-Coyotzi 2015), the Caribbean Sea (Vera-Caripe et al. 2012) and Brazil (Souza et al. 2011; Santos et al. 2012, Soledade and Almeida 2013 and all previous records mentioned there in, Giraldes and Freire 2015, Anker et al. 2016).

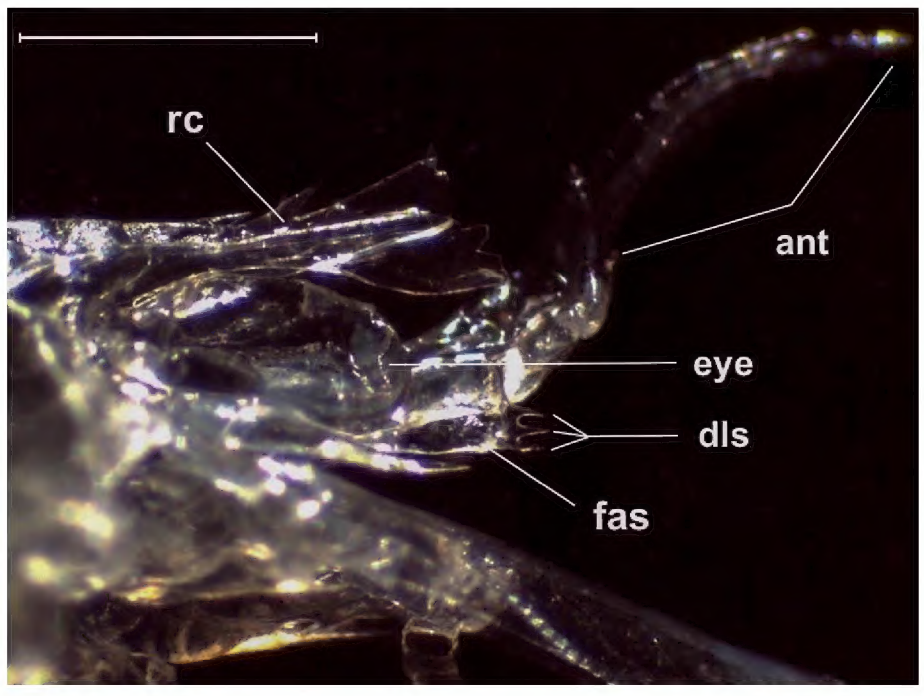

Figure 5. *Hippolyte obliquimanus*, male (UANL-FCB-C20-8137), anterior region with cephalic appendages, lateral view. Scale bar = 1 mm. (fas: first antennular peduncle segment; dls: distolateral spines; ant: antennule; rc: rostral carina).

Family Hippolytidae Spence-Bate, 1888

***Hippolyte obliquimanus* Dana, 1852**

Figure 5

Material examined. 1 specimen, heavily damaged, ♂. On seagrass beds. 5 August 2014 (UANL-FCB-C20-8137), S2 (24°29.1833′ N, 097°41.9667′ W).

Distribution. North Carolina, south to Florida, through the Caribbean to Brazil (d'Udekem d'Acoz 1997); in Mexico from Laguna Madre, Tamaulipas (this study [new record]) to Quintana Roo (Escobar 1984, Román-Contreras 1988, Hernández et al. 1996, Rodríguez et al. 2000, Román-Contreras and Martínez-Mayén 2010, Hermoso-Salazar and Arvizu-Coyotzi 2015).

Previous records from Laguna Madre. None. New record.

Remarks. Previous records for the Gulf of Mexico in USA are inexistent, except those from Florida. *Hippolyte curacaoensis* is considered a junior synonym of *H. obliquimanus* (d'Udekem d'Acoz 1997). It differs from its closest relative reported for the area, *H. zostericola*, by having a rostrum usually armed with 3 or 4 strong teeth on dorsal margin, a strong lateral carina in proximal third of length, and the basal segment of antennular peduncle armed with 1–3 strong distolateral spines (Figs. 5, 6A, B) (Abele and Kim 1986; d'Udekem d'Acoz 1997). All these previous features were observed in the collected material.

***Hippolyte zostericola* (Smith, 1873)**

Figure 6A, B

Material examined (1825 specimens). On seagrass meadows of *Syringodium filiforme* and *Halodule wrightii*. 8 March 2014 (UANL-FCB-C20-8117), S1(24°29.1000′ N, 097°41.4500′ W), 294 specimens (240♀, 54♂); 8 March 2014 (UANL-FCB-C20-8124), S2 (24°29.1833′ N, 097°41.9667′ W), 312 specimens (307♀, 5♂); 9 March 2014 (UANL-FCB-C20-8129), S3 (24°29.2667′ N, 097°45.9833′ W), 64 specimens (♀); 5 August 2014

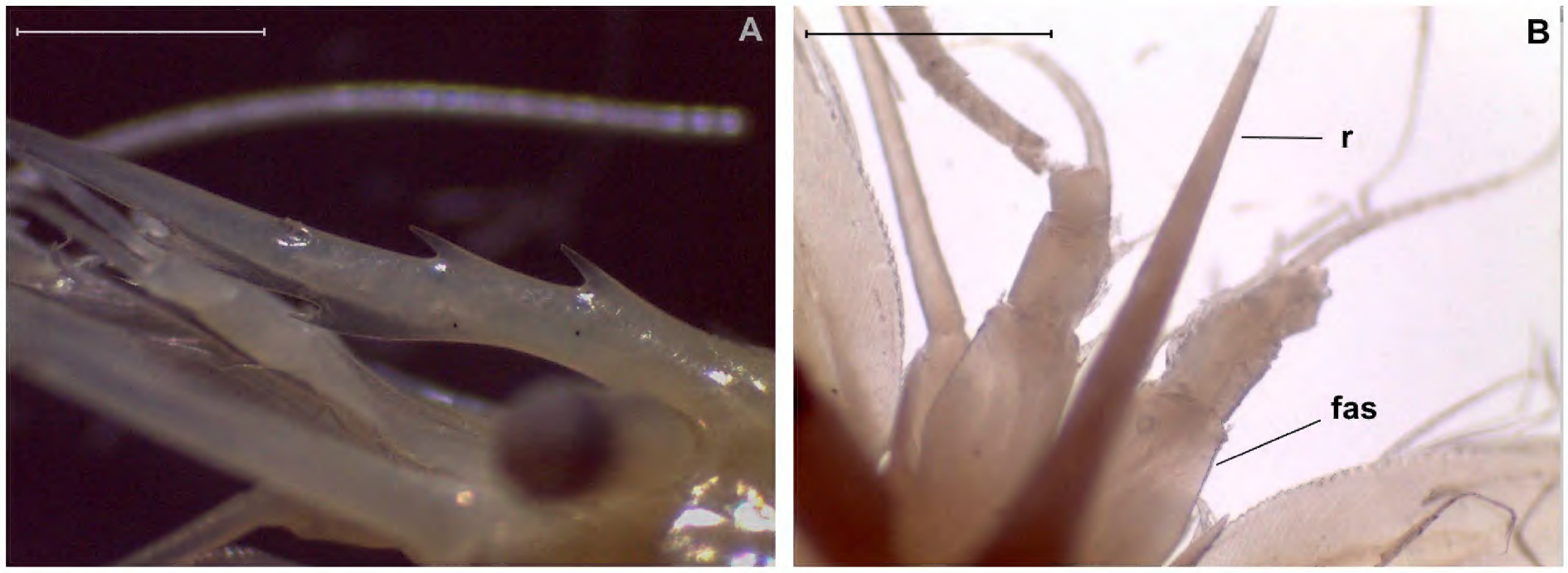

Figure 6. *Hippolyte zostericola*, female (UANL-FCB-C20-8124): (**A**) rostrum, lateral view; (**B**) antennular peduncle, dorsal view. Scale bars = 1 mm. (r: rostrum; fas: first antennular peduncle segment).

(UANL-FCB-C20-8140), S2 (same point), 21 specimens (♀); 5 August 2014 (UANL-FCB-C20-8148), S3 (same point), 8 specimens (7♀, 1♂); 17 February 2017 (UANL-FCB-C20-8152), S1 (same point), 248 specimens (170♀, 78♂); 17 February 2017 (UANL-FCB-C20-8155), S2 (same point), 856 specimens (599♀, 255♂); 18 February 2017 (UANL-FCB-C20-8159), S3 (same point), 22 specimens (21♀, 1♂).

Distribution. From Massachusetts, USA, and Bermuda, south to Florida, Trinidad and Curaçao (Chace 1972, Markham and McDermott 1980, Zupo and Nelson 1999). Through Gulf of Mexico from Redfish Bay Texas to Quintana Roo (Chace 1972, Wicksten 2005b, Román-Contreras 1988, Markham et al. 1990, Román-Contreras and Romero-Rodríguez 2005, Román-Contreras and Martínez-Mayén 2010). Also present for eastern Pacific in San Antonio, Robles municipality, Tumaco, western Colombia (Wicksten 1989, Lemaitre and Álvarez-León 1992).

Previous records from Laguna Madre. Hildebrand (1958), Barba-Macías (1999), Lower Laguna Madre, Texas (Sheridan and Minello 2003), Laguna Madre of Texas, Corpus Christi Bay (Sheridan 2004), Barba-Macías et al. (2005), Barba-Macías (2012).

Tozeuma carolinense Kingsley, 1878

Material examined (415 specimens). In seagrass beds. 8 March 2014 (UANL-FCB-C20-8121), S1(24°29.1000′ N, 097°41.4500′ W), 2 specimens (♀); 8 March 2014 (UANL-FCB-C20-8128), S2 (24°29.1833′ N, 097° 41.9667′ W), 35 specimens (14♀, 21♂); 9 March 2014 (UANL-FCB-C20-8132), S3 (24°29.2667′ N, 097° 45.9833′ W), 67 specimens (33♀, 34♂); 5 August 2015 (UANL-FCB-C20-8138), S2 (same point), 73 specimens (44♀, 29♂); 5 August 2014 (UANL-FCB-C20-8150), S3 (same point), 238 specimens (193♀; 45♂); 17 February 2017 (UANL-FCB-C20-8156), S2 (same point), 4 specimens (2♀, 2♂); 18 February 2017 (UANL-FCB-C20-8160), S3 (same point), 14 specimens (12♀, 2♂).

Distribution. From Massachusetts, USA, and Bermuda, to Sao Paulo, Brazil including Gulf of Mexico, Cuba, Isla Santa Lucía and Curaçao (Chace 1972, Markham and McDermott 1980, Williams 1984, Hernández et al. 1996, Martínez-Iglesias et al. 1996, Christoffersen 1998); in Mexico from Tamaulipas (Laguna Madre, see references below) to Quintana Roo (Chace 1972, Román-Contreras 1988, Markham et al. 1990, Hernández et al. 1996).

Previous records from Laguna Madre. Hildebrand (1958); Barba-Macías (1999); Rodríguez et al. (2000); as *Tozeuma carolinensis* by Leija-Tristán et al. (2000); in Laguna Madre of Texas by Sheridan and Minello (2003); Corpus Christi Bay and adjacent zones (Sheridan 2004); Barba-Macías et al. (2005); Barba-Macías (2012).

Remarks. Our material agreed with the description in Abele and Kim (1986). This species is recognized by its elongated and dorsally unarmed rostrum.

Superfamily Processoidea Ortmann, 1896

Family Processidae Ortmann, 1896

Ambidexter symmetricus **Manning & Chace, 1971**

Material examined. 8 March 2014 (UANL-FCB-C23-8164), S1 (24°29.1000′ N, 097°41.4500′ W), 1 specimen (♀); in seagrass meadows of *Syringodium filiforme* and *Halodule wrightii*.

Distribution. Gulf of Mexico, to Trinidad (Chace 1972); western Atlantic from Florida to Brazil (Christoffersen 1998); Tamaulipas, Mexico; Louisiana, Florida, Puerto Rico, Trinidad (Abele 1972).

Previous records from Laguna Madre. Barba-Macías (1999); Laguna Madre of Texas (Sheridan and Minello 2003); Barba-Macías et al. (2005).

Remarks. The features observed agreed with those included in Abele and Kim (1986).

Key for the taxonomic identification of caridean shrimps associated with seagrass beds from the southern region of Laguna Madre

(Adapted from Chace 1972, Williams 1984, Abele and Kim 1986)

1 Carpus of second pair of pereopods entire (Palaemonidae) 2

1′ Carpus of second pair of pereopods subdivided 7

2 Carapace without branchiostegal groove ventral to antennal spine; endopod of the first pleopod of male with an appendix interna (genus *Leander* E. Desmarest, 1849); lateral extension of anterior margin of basal antennular segment concave or straight; stylocerite may reach to distal third of basal antennular segment; rostrum shallow in mature males, but very deep in mature females; fingers of second pereopod unarmed ..... *Leander tenuicornis* (Say, 1818)

2′ Carapace with branchiostegal groove; endopod of the first pleopod of male entire, without appendix interna (genus *Palaemon* Weber, 1795) 3

3 Mandible usually with palp, formed by 2–3 articles; rostrum curved upwards (Fig. 2)..... 4

3′ Mandible usually without palp; rostrum straight or less curved upwards (Fig. 3)..... 5

4 Rostrum high, ventral margin with 3 or 4 teeth ..... *Palaemon northropi* (Rankin, 1898)

4′ Rostrum slender, ventral margin with 5 or 7 teeth .... *Palaemon floridanus* Chace, 1942

5 Rostrum with 2 dorsal teeth behind posterior margin of orbit, teeth reaching to tip, 3–5 ventral teeth; dactylus of second pereopod with 2 teeth, immovable finger with 1 tooth on cutting edge .... *Palaemon vulgaris* Say, 1818

5′ Rostrum with only 1 dorsal tooth behind posterior margin of orbit; dactylus of second pereopod may have a tiny blunt tooth or may be unarmed, fixed finger without tooth on cutting edge 6

6 Rostrum with dorsal teeth reaching to often bifurcate tip; 4 or 5, seldom 3, ventral teeth; dactylus of second pereopod with tiny and sometimes blunt tooth .... *Palaemon mundusnovus* De Grave & Ashelby, 2013

6′ Both margins of rostrum with unarmed stretch before dagger-shaped tip; 2–5, generally 3, ventral teeth; fingers of second pereopod without teeth on cutting edge ..... *Palaemon pugio* (Holthuis, 1949)

7 Chelae of first pair of pereopods distinct, at least on one side; first pair of pereopods both chelate; rostrum dentate or unarmed, not with single subdistal dorsal tooth 8

7′ Usually right first pereopod chelate, the other ending in simple claw-like dactyl; if both chelate, rostrum with subdistal dorsal tooth (Processidae); first pereopods similar, both chelate and lacking exopods; second pereopods symmetrical .... *Ambidexter symmetricus* Manning & Chace, 1971

8 Fingertips of first pair of chelae usually dark colored; first pair of chelipeds short and rather heavy but not swollen; eyes free, never extremely elongate (Hippolytidae) 9

8′ Fingertips of first pair of chelae not dark colored; eyes never extremely elongate; first pair of pereopods distinctly stronger than second, often consisting in major and minor chelae (Alpheidae); eyes covered by carapace, epipods present on at least first 2 pairs of pereopods (genus *Alpheus* Fabricius, 1798) 11

9 Body short, total length 14 mm in males, 15.5 mm in females; rostrum shorter or longer than carapace, but clearly less than 1.3 times its length; supraorbital tooth present; with 1–3 (usually 2) dorsal and 1–4 ventral teeth (genus *Hippolyte* Leach, 1814) 10

9′ Body elongated, maximum length of males 40 mm, females 50 mm; rostrum noticeably longer than carapace, 1.4 times to nearly twice its length; supraorbital tooth absent; rostrum unarmed dorsally and with up to 19 ventral teeth .... *Tozeuma carolinense* Kingsley, 1878

10 Rostrum armed with 3 or 4 strong teeth on dorsal margin and with a strong lateral carina in proximal third of length; rostrum reaching beyond end of antennular peduncle in both sexes; basal segment of antennular peduncle armed with 1–3 strong distolateral spines (Fig. 5) ..... *Hippolyte obliquimanus* Dana, 1852

10′ Rostrum usually armed with 2 (rarely 1 or 3) strong teeth in proximal half of dorsal margin and without distinct lateral carina; rostrum reaching beyond antennular peduncle in females and nearly to distal margin of second antennular segment in males; first segment of antennular peduncle unarmed (Fig. 6A, B) .... *Hippolyte zostericola* (Smith, 1873)

11 Major first chelae superiorly and inferiorly notched; merus of fisrt pereiopods unarmed distoventrally; major chela with distal ends of propodus and dactyl rounded; upper margin deeply notched forming saddle-like depressions .... *Alpheus heterochaelis* Say, 1818

11′ Major first chelae not notched inferiorly; merus armed distoventrally with one large spine and 2–4 smaller spines; major chela with distal ends of propodus and dactyl narrowly-rounded; upper margin of propodus deeply notched with depression ending distally in acute-overhanging tooth (Fig. 4D, F) .... *Alpheus* cf. *packardii* Kingsley, 1880

Discussion

In recent years, several aspects of Laguna Madre of Tamaulipas have been analyzed, with major focus on species with great importance to local fisheries, like peneaid shrimps, fishes, and oysters (Rendón-von Osten and García-Guzmán 1995). Although no population of caridean shrimp species has been commercially exploited in

the lagoon, these shrimps have been studied due to their important ecological relevance. As a result, not only their diversity, richness, and habitat-associated distribution patterns have been documented, as well as their biomass and variations of density (Barba-Macías 1999, 2012, Barba-Macías et al. 2005), but also species lists (Rodríguez et al. 2000, Leija-Tristán et al. 2000) and restoration assessments of submerged aquatic vegetation-covered areas have been done (Sheridan and Minello 2003, Sheridan 2004, King and Sheridan 2006).

This study reports 12 caridean shrimp taxa, showing a higher species richness than most previous studies in the system (Barba-Macías 1999, 2012, Rodríguez et al. 2000, Barba-Macías et al. 2005), but not as many species (14) as recorded by Leija-Tristán et al. (2000). The observed richness is due to the influence of tropical and subtropical waters masses from Caribbean–Carolinian marine provinces, which explains the convergence of different types of fauna (Barba-Macías et al. 2012).

The family Hippolytidae was the most abundant, with high numbers of individuals of *Hippolyte zostericola* and *Tozeuma carolinense*, followed by Palaemonidae with abundant records of *Palaemon vulgaris, P mundusnovus, P. floridanus* and *P. pugio*. Finally, Alpheidae and Processidae were the least abundant families. Commonly, alpheid shrimp richness is higher in tropical regions (Anker et al. 2006), whereas palaemonid and hippolytid shrimps are proportionally more abundant in temperate shallow water environments, especially those with SAV substrates (López de la Rosa et al. 2002, Glancy et al. 2003). Estuarine fauna is distinguished by its tolerance to salinity variations, displaying strategies like high growth rates, rapid colonization, and high but variable abundances under suitable environmental conditions (Rendón-von Osten and García-Guzmán 1995, Kennish and Paerl 2010).

Hippolyte zostericola was the most abundant species with 1,825 specimens, being higher in February > March > August, and at S2 > S1 > S3, maybe in response to the raised temperatures and salinities registered in August, as well as to a less seagrass structural coverage observed. Abundance of this shrimp has been correlated with water depth, and seagrass coverage and morphology as part of an adaptive response to improve avoidance of visual predators (Howard 1984, Zupo and Nelson 1999); furthermore, Zupo and Nelson (1999) also found that the positive correlation of *H. zostericola* abundance and water depth was consistent with negative phototropism, as part of the same predator-avoidance mechanism. Along with this, a potentially important predatory interaction has been noted between *H. zostericola* and *Palaemon mundusnovus,* indicated by the significant inverse correlation of abundance of both species, and being demonstrated in laboratory experiments (Zupo and Nelson 1999). In this work, maximum abundance of *H. zostericola* was observed at S2, whereas *P. mundusnovus* was virtually absent (only 1 specimen found), which could be associated with the aforementioned predator–prey interaction, as well with more suitable conditions of water depth and seagrass coverage observed at the site. Nevertheless, this species is a common and dominant element in estuarine environments along Gulf of Mexico, due to its wide physiological tolerance to salinity changes (Barba-Macías et al. 2005), and further studies should be performed to better understand its ecological behavior in the area.

Another dominant hippolytid shrimp was *Tozeuma carolinense,* with 431 collected specimens. This species, as well as *Hippolyte zostericola*, is less represented under mesohaline water conditions (Sánchez et al. 1996) and strongly associated with SAV meadows, commonly being attached to seagrass and macroalgae leaves, feeding on epiphytes and sheltering from predators (Kneib 1988). Both species were absent at S1 during August and February, maybe as a result of an increase in predation by fishes foraging near the inlet, which changes their diets throughout rainy season, primarily feeding on macrocrustaceans (Barba-Macías 1999). However, *T. carolinense* was poorly represented at this station in March as well, whereas *H. zostericola* remained abundant. Other factors like tidal variations, less observed density of *Syringodium filiforme* in March and February, sampling effort, or the more euhaline–mesohaline waters occurring adjacent to Boca de Catán inlet could be influencing this phenomenon.

Lesser abundances for Alpheidae might be explained by the geographical distribution of the family, highly diverse and inhabiting a great variety of marine and estuarine habitats in tropical waters (Anker et al. 2006), suggesting less richness and abundance towards Laguna Madre region. Lower representation could also be related to sampling exclusion, derived from the use of a selective epifaunal sampling method over SAV, excluding habitats such coral and rocky substrates where alpheid shrimps are commonly found, given their infaunal burrowing habits in those areas (Bauer 1985, Román-Contreras and Martínez-Mayén 2010, Barba-Macías 2012). The only record of a processid shrimp was for *Ambidexter symmetricus* at S1, but it was absent in the inner zones of the lagoon, which have euhaline-hypersaline waters and extensive SAV meadows. . However, this shrimp has been recognized as a rare or occasional element in Laguna Madre (Barba-Macías 1999, Barba-Macías et al. 2005), and more associated with inlet areas, euhaline conditions, less variable salinity and temperature, deeper zones, and bare sandy substrates (without SAV) (Barba-Macías 1999). Furthermore, it has been noted that processid shrimps are mostly nocturnal and that *A. symmetricus* is difficult to collect due to its cryptic habits (Pachelle et al. 2016, Santana-Moreno et al. 2016), so its presence could be accidental.

We provide 4 new records for the study area: *Palaemon floridanus, P. northropi, Alpheus* cf. *packardii* and *Hippolyte obliquimanus*. The last species has been mostly recorded in estuaries along southern Gulf of Mexico (Escobar 1984, Hernández et al. 1996, Rodríguez et

al. 2000, Román-Contreras 1988, Román-Contreras and Martínez-Mayen 2010, Hermoso-Salazar and Arvizu-Coyotzi 2015), and in estuarine zones of Florida (d'Udekem d'Acoz 1997), but absent for the rest of the U.S. Gulf coast. The northernmost records in Mexico are known for Laguna de Tamiahua, Veracruz, and coral reefs of Veracruz state (Rodríguez et al. 2000).

Hippolyte obliquimanus was collected at S2 in August, over seagrass meadows primarily composed by *Syringodium filiforme* and *Halodule wrightii* and represented by only 1 damaged specimen (Fig. 5). Nevertheless, it was possible to observe its distinct morphological features (see species remarks in results section). This species was absent in the other sampling stations despite the presence of SAV. It prefers shallow water environments, among *Sargassum* sp. algae (Mantelatto et al. 1999) and seagrass meadows (*Thalassia testudinum* and *S. filiforme*) (d'Udekem d'Acoz 1997), on muddy and sandy bottoms (Chace 1972); these same habitats are common in Laguna Madre of Tamaulipas (Estavillo and Aguayo 1985, Rendón-von Osten and García-Guzmán 1995). This only record was thought to be due to its occasional presence associated with seasonality and abundance of *Sargassum* sp. The density of *Hippolyte obliquimanus* is higher in autumn-winter periods in association with these algae (Terossi and Mantelatto 2010), which also influence variations in abundance of many caridean shrimp species (Leite and Turra 2003). The decrease in abundance of *Sargassum* sp. promotes the migration of associated caridean shrimps to deeper zones, which typically occurs during spring-summer in tropical regions, as a result of the rising temperatures (Terossi and Mantelatto 2010). In Laguna Madre, *Sargassum* sp. enters during spring, drifts through the system, including the sampling zone (Barba-Macías 1999), and leaves in early summer (Breuer 1962) as temperature increases. This dynamic might explain the observed abundance of *H. obliquimanus*, which could have entered to the system during spring among *Sargassum*, decreasing in number towards August as a result of a decreased *Sargassum* abundance and rising temperatures, thus searching for areas with SAV and deeper/cooler waters.

Reproductive traits could also be involved in the occurrence of *Hippolyte obliquimanus*. Clarke (1987) suggested that the reproductive output of some hippolytid shrimps decreases with increasing latitude. This was confirmed by Terossi et al. (2010), who observed lower mean reproductive output in populations from Brazil (23° S) than those from Costa Rica (09° N). Moreover, Woodward and White (1981) suggested that lower temperatures allow for a higher energy investment in embryo production, compared to animals living in warmer waters (Díaz 1980). However, Terossi and Mantelatto (2010) recommended that considerations should be given to local and regional environmental conditions that might contribute significantly to the plasticity of the reproductive biology of decapods. Although we collected only 1 specimen of *Hippolyte obliquimanus*, a nearby occurrence from Laguna de Tamiahua, Veracruz, makes it likely that there are well-established populations in Laguna Madre and possibly along the rest of the U.S. Gulf coastline; we attributed the scarcity of records to a lack of sampling effort.

Palaemonidae showed the highest species richness with 6 species. Within this family, the genus *Palaemon* comprised 5 species, decreasing in abundance as follows: *Palaemon vulgaris, P. mundusnovus, P. floridanus, P. pugio* and *P. northropi*. Palaemonid shrimps are abundant in tropical and temperate estuaries over the world, serving as detritivores, small invertebrate predators and an important food source for several fish and bird species (Bauer 2004).

Here we report 2 new records for Laguna Madre and estuarine environments of Tamaulipas: *Palaemon floridanus* and *P. northropi*. *Palaemon floridanus* has no previous records along the Mexican Gulf, with just 1 nearby record from Padre Island and Laguna Madre of Texas (Strenth and Chace 1995). Its range includes the Gulf of Mexico, Caribbean Sea and adjacent zones (Chace 1942, Coen et al. 1981). On the other hand, *P. northropi* has been observed in Laguna de Términos, Campeche, and several points along Quintana Roo (Chace 1972, Román-Contreras 1988, Hernández et al. 2005), over a wide area from Bermuda to Uruguay (Holthuis 1952).

Given their distribution range, the scarcity of published records around the study area is interesting, and might be due to a lack of surveys dealing with this genus in North America (Knowlton and Vargo 2004), which is supported by the notable difference in time between this study and the only local record of the genus (*Palaemon floridanus*) made by Strenth and Chace (1995) (19 years apart).

Palaemon floridanus also has been associated with red algae like *Digenia simplex*, *Laurencia poitei* and some species of *Gracilaria* (Hooks et al. 1976). Considering that most of the studies in the region addressed the relation of caridean shrimps with seagrass substrates (Barba-Macías 1999, 2012, Sheridan and Minello 2003, Sheridan 2004, Barba-Macías et al. 2005, King and Sheridan 2006), it is possible that habitat preferences are influencing the recorded occurrences; however, studies have not been carried out to clarify this relationship. Coen et al. (1981) found post-larvae and juvenile specimens among litter of *Thalassia testudinum* and *Syringodium filiforme*, species also occurring in Laguna Madre, posing the need for regular samplings for a better understanding of the frequency of this shrimp in the ecosystem. In their study, Strenth and Chace (1995) mentioned that it is common during spring and summer months, and ovigerous females are present from March to September, reaching their maximum size in January and February. Our material of *Palaemon floridanus* is from August, with ovigerous females present, which suggests that suitable conditions allow for their growth early in the year and for development of their eggs later in spring and summer; this supports the idea of a well-settled species at least in Laguna Madre, and probably in other coastal lagoons or

estuarine environments along Mexican Gulf coastline.

Palaemon northropi had no previous records in the region until this work, which, in addition to the lack of studies, could be due to a inappropriate sampling method, as well as this species' preference for more marine habitats (Anger and Moreira 1998, Pralon and Negreiros-Fransozo 2006) and not being commonly associated with SAV habitats, as are other caridean shrimp species.

Another new record for Laguna Madre is *Alpheus* cf. *packardii*. This shrimp ranges from North Carolina, Bermuda, Gulf of Mexico, Caribbean Sea, and Brazil (Anker et al. 2016) and with records in the Gulf of Mexico from Key West, Florida and Texas (Christoffersen 1979); Mexican records includes coral reefs off Veracruz (Hernández et al. 1996, Hermoso-Salazar and Arvizu-Coyotzi 2015), but it is absent from the rest of the Gulf coast both in Mexico and the U.S. Our material consists of few specimens, which we attribute to an inappropriate sampling method considering their habitat preferences (Bauer 1985, Román-Martínez 2010, Barba-Macías 2012). In Laguna Madre, the genus *Alpheus* has been related to SAV, but showing low abundance, density and biomass, and representing a rare or occasional element (Barba-Macías 1999, Barba-Macías et al. 2005). Moreover, the distribution patterns of alpheid shrimps are difficult to study since alpheids tend to form cryptic species complex (Anker 2001, Almeida et al. 2007, 2012), which pose future challenges as nomenclature and geographic distribution of the genus Alpheus are expected (Anker et al. 2007).

Our work contributes to the knowledge of the caridean shrimp fauna in the southern region of Laguna Madre, adding new species to the list for the area and extending species' ranges in the Gulf of Mexico. It will be necessary to design sampling methods fitted to the biology of each species in this group, to better describe their structure, ecology, and dynamics, Future studies on caridean shrimp might be useful for potential conservation and maintenance of habitat integrity, and thus, giving support to many other ecologically and commercially relevant organisms. Our contribution also sets a precedent to aim efforts towards the clarification of geographic distribution, taxonomy, and even systematic status of this important and diverse decapod group.

Authors' Contributions

HHB and ALT collected the specimens; HHB identified the seagrass material; HHB, ALT, and SFL wrote the text; HHB and ALT identified the caridean shrimps.

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